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ABSTRACT

Research environments of four leading universities were studied: University of California at Berkeley (UC-Berkeley), Harvard University, Massachusetts Institute of Technology (MIT), and Stanford University. Attention was directed to organizational responses for encouraging collaboration in research at these leading universities, as well as to implications for encouraging excellence in research at other institutions that are striving for increased productivity and quality during hard times. Two independent organized research groups located at Stanford University, SRI International and the Center for Advanced Study in the Behavioral Sciences, helped promote research vitality at the university. At MIT, there is an emphasis on innovation and high levels of communication between disciplines, and a willingness to take risks in an uncertain environment. Internal organizational reforms at MIT include a new definition of faculty associated with organized research units. UC-Berkeley has experimented with a governance process to help reorder departmental boundaries in an academic area so that the reorganized units are less damaging to the development of new fields of study. Harvard has increased ties with industry and business, which provide opportunities to promote technological developments. (SW)

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EXCELLENCE IN RESEARCH: CREATIVE ORGANIZATIONAL RESPONSES AT BERKELEY, HARVARD, MIT, AND STANFORD

John J. Gardiner

Paper Presented at the Annual Meeting
of the Association for the Study of Higher Education
Chicago, Illinois
March 17, 1985

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EXCELLENCE IN RESEARCH: CREATIVE ORGANIZATIONAL RESPONSES AT BERKELEY, HARVARD, MIT, AND STANFORD*

John J. Gardiner

In a post-industrial society, emphasis in research changes from information gathering to information processing [71, 72] . Collaboration is needed to build bridges between and among large pools of disciplinary information on the one hand and society's increasingly complex problems on the other. If the future of an information society depends upon the effectiveness of its research effort, then one area worthy of analysis is the collaborative work structure that exists in and around that society's leading research universities. These universities, eminent, innovative, and successful in research, offer ideal environments for the emergence of creative organizational forms that might be considered as models for improving information processing within the rest of that society.

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Setting the Context

Damage to the research effort of the nation will result from the fiscal crisis of the state and from expected decrease in the numbers of new faculty [17, 40, 57, 65]. "With fewer students and relatively less money, higher education institutions are in stable or decreasing modes--which in turn affects the viability of the research enterprise--yet, at the same time, there is renewed national interest in maintaining a vital research enterprise" [65, p.v].

While universities have been the principal site of basic research in the United States, pluralism in the conduct of research has been a fundamental characteristic of the American system [3, 65]. Organizations active in scientific research like the Smithsonian Institution and the U.S. Department of Agriculture can trace their roots back into the nineteenth century; independent research institutes, federal laboratories, research and development centers in industry and business have been an integral part of the American research enterprise for the past several decades.

Just as pluralism has characterized the whole of the American research enterprise, diversity, ambiguity, and slack have characterized its constituent parts [24, 38, 45, 51, 88]. In contrast, European higher education has been found to be inefficient with regard to research productivity as a result of that system's

organizational inflexibility within and between academic units [6, p.84].

In view of today's need for increased creativity and risk-taking in university research, the loosely coupled structure of the multiversity should be viewed as an organizational advantage. As Clark Kerr noted, "The multiversity has demonstrated how adaptive it can be to new opportunities for creativity; how responsive to money; how eagerly it can plan a new and useful role; how fast it can change while pretending that nothing has happened at all; how fast it can neglect some of its ancient virtues" [38, p.45].

The strength of America's research enterprise lies in its flexibility. "In loosely coupled systems where the identity, uniqueness, and separateness of elements is preserved, the system potentially can retain a greater number of mutations and novel solutions than would be the case with a tightly coupled (homogeneous) system. A loosely coupled system could preserve more 'cultural insurance' to be drawn upon in times of radical change than in the case of a more tightly coupled system " [88, p.7].

Flexibility--diversity, ambiguity, and slack--has also been evident in institutional mission. "The last several decades have seen a remarkable broadening in the range of tasks which higher education is expected to perform in American society, and a dizzying array of judgments and perspectives about how well it is

doing its various jobs" [49, p. 243]. The university's boundaries within American society are increasingly blurred. The ivory tower has disappeared [10, p.7]; the drawbridges across the old moat surrounding the university are down [37, p.582]. State and federal government, business and industry cross the bridges on the way in; activist students and faculty on the way out. The assault is on; academic freedom, internal governance, and institutional autonomy are all in jeopardy [10, 37, 55]. In 1985, the American university stands at the hinge of history uncertain where its future lies.

The academic department, in the United States and in Europe, had been built using the paradigm of teaching discipline; research was not considered in establishing the initial framework [6, p.31]. Emerging organizational forms, university centers and institutes, did not suffer the same disadvantage. These organizational adaptations "which decoupled the conduct of scientific research from the education of students" are being viewed as "one possible response to the threat of reduced vitality of academic science" [17, p.91]. Organizational variations such as institutes and centers permit the university to increase its research vitality at the same time it grows more responsive to societal needs [23, 33, 48, 61, 78]. Organized research units (ORU's) provide opportunities for a flexible university with inflexible academic units to adapt to a rapidly changing society, full of people demanding increased responsiveness and greater accountability. While power remains with academic departments, the

future belongs to evolving organizational forms growing within their shadows.

Research Productivity, Organizational Context, and Collaborative Work Structures

In their analysis of research, Smith and Fiedler noted three ways to assess productivity--which they equated with excellence: counting a scholar's (or department's) publications; rating the quality of a scholar's (or department's) published research; and counting the number of citations made of a scholar's (or department's) work. While each of these methods had it weaknesses, counting the number of citations was identified as the most acceptable way to measure research productivity/excellence [77, p.225-32]. Cole and Cole observed that "straight citation counts are highly correlated with virtually every refined measure of quality" [16, p.35].[1]

Washburn, investigating standards of excellence in fifteen departments at Stanford University, asked faculty to select characteristics they considered most important in determining departmental excellence. The average number of journal articles published per professor per year was chosen most often as being very important for assessing departmental excellence; the second characteristic identified was the proportion of faculty conducting research or scholarly work with external funding. Washburn concluded that "standards of departmental excellence

appeared to be narrowly conceived manifestations of professors' complex value systems" [86, p.150-1, 368]. "Pursuit of prestige--of recognition by one's academic and scholarly peers--is deeply engrained in most faculty members and reflects the norms and standards they have internalized after years of training. As such, prestige is an essential feature of the social system of the scientific and academic community" [28, p.22-3]. As Christopher Jencks and David Riesman noted, "The extraordinary high degree of consensus about the relative standing of departments in all academic fields suggests that the standards used to evaluate departments must be quite uniform. Rankings over time also show remarkable stability" [36, p.13]. Despite a lack of focus in criteria for determining refereed journals [53], criteria for selecting articles [70], criteria for determining research productivity within specific disciplines [85], prestige maximization has encouraged a more or less constricted definition of academic excellence. "In no other major social institution is the process of stratification more universalistic" [16, p.122].

Fulton and Trow pointed to the great diversity found within American higher education with rates of participation in research ranging from 9% to 91% of the faculty in various types of institutions and within various subject fields. As a result, they emphasized the need to study institutional and/or departmental contexts, the "research climate" [24, p.47-9]. Research productivity, however operationally defined, appeared to be influenced

by organizational context.

Long and McGinnis observed that "within three to six years of obtaining a position in a specific context, a scientist's level of productivity conforms with the characteristics of that context, independent of previous productivity... Past research indicating that the most productive scientists are recruited to academic locations may be confusing the cause of a scientist working in a given organizational context with the effect of working in that context" [43, p.439-41]. The quality of both graduate institution and employer institution affected research productivity [1, p.264-5]; initial employment in a university setting was a more important determinant of long-term productivity than graduate or employer institution [67, p.499-500]. Organizational context clearly influenced research productivity.

While the role of the individual in basic research had not lessened, the use of research teams had increased. As a report of the National Academy of Sciences noted, "Today, effective research often requires close collaboration among investigators from different disciplines" [57, p.485]. The creation and diffusion of technological knowledge, a process which is at the heart of modern economic growth, requires the use of matrix teams employing interdisciplinary techniques.

"Studies have indicated that participation tends to be greater in the better-known, more productive and research-oriented universities and departments... if any general conclusions at all

can be drawn from the American experience, participation seems to be associated with greater productivity in research" [81, p.7]. Harriet Zuckerman, in her comprehensive analysis of Nobel laureates, noted that "quite contrary to the twin stereotypes that scientists, especially the better ones, are loners and that important scientific contributions are the products of individual imagination, the majority of investigations honored by Nobel awards have involved collaboration" [92, p.176]. In fact, Zuckerman discovered that laureates had "consistently higher rates of collaboration at each phase of the life work-cycle" [91, p.395]. Excellence in research was closely tied to collaboration [18, 26, 57, 62, 81, 91, 92].

"The need to assess the consequences of collaboration brings us again to the tension between the individualism of scientists and the communialism of the scientific enterprise...increasingly, communalism in science is manifest in collaborative or coauthored work which has grown dramatically over the past several decades" [22, p.356,348]. An increase in the rates of collaboration has been well documented both within and between fields [22, p.348; 92, p.176-7]. This increase in collaboration has been attributed to such factors as patterns of funded research, specialized research technology, increasing professionalization of science, and the maturation of disciplines [22, p.356].

McHenry, a farmer and university president, noted in the

introduction to his book on academic departments, "in scholarship, as a farming, the most fertile soil may be that under the fences rather than at the center of long established fields" [48, p.ix]. As disciplines grew more arcane, it became harder and harder for faculty in the same college to communicate with one another...important discoveries were being made at the frontiers of knowledge where the real communities of scholars still dwelled, but the average faculty member did not live there" [25, p.3-4].

Herbert Simon observed that "the information-processing systems of our contemporary world swim in an exceedingly rich soup of information, of symbols. In a world of this kind, the scarce resource is not information; it is processing ability to attend to information" [71, p.270]. We are suffering from a "new form of intellectual malnutrition: too much disorganized information and too little of the knowledge we need" [19, p.19]. At the same time, our species' unique sense of intellectual superiority is being challenged by advances in computer design and information-processing programs [72, 74]. "The computer not only reduces the costs of the information-processing operations that it automates but also contributes to the productivity of the activities themselves" [74, p.1187].

A central concern of American higher education with regard to the research process is "a sparseness of social networks as an infrastructure of meaning formation" [39, p.64]. Information, accumulating at an exponential rate, has been

creating a lag in meaning formation. Diana Crane noted that "the problems of scientific communication can be understood in terms of interaction between a complex and volatile research front and a stable and much less flexible formal communication system" [18, p.128]. One front created the new knowledge; the other evaluated and disseminated it. Both fronts need greater flexibility in organizational structures and communication systems to increase responsiveness to an information-processing society. The organization and communication structures of American higher education are being challenged by the enormous growth of new knowledge and a need for its processing. "Research is essentially a corporate activity...It is not enough to observe, experiment, theorize, calculate, and communicate; we must also argue, criticize, debate, expound, summarize, and otherwise transform the information that we have obtained individually into reliable, well-established, public knowledge" [90, p.324]. Are new organizational forms emerging within and around America's leading research universities which could help meet the challenge of improved knowledge processing for the emerging information society?

In Bernard Berelson's study of Graduate Education in the United States, the author noted, "It is easy to add to the top ten institutions but hard to displace them. A major push can

move an institution ahead in a decade or so but it typically takes more like a quarter century to get into the top ranks. As for the top ten, no new comer has displaced the institutions that were established in graduate study decades ago" [7, p.98]. This last observation noted by Berelson, in his 1960 study of graduate education in the United States, has been challenged. "MIT, reflecting its evolution from a technical school to a more clearly comprehensive university, has improved fourteen places, from 19th (1925) to 5th (1982), with its biggest leap coming since 1970. Stanford, perhaps one of the brightest success stories among major universities of the 20th century, has steadily advanced from 14th (1925) to 2nd (1982)" [87, p.22]. The revolutionary leap of MIT and Stanford into top five ranking has offered an opportunity for consideration of how research excellence is achieved organizationally at America's leading universities. Berkeley's first place domination of the ranking surveys for decades also makes it an ideal institution for consideration as a model of excellence, as does Harvard's high ranking in the survey (second or third place) for the past several decades. Organizational responses to the competitive research environments found in and around the University of California, Berkeley, Harvard University, the Massachusetts Institute of Technology, and Stanford University might offer insights regarding the need for improved knowledge processing for the emerging information society.

Research Questions and Methodology

For purposes of this study, the following research questions were considered:

(1) What organizational responses for encouraging collaboration in research have emerged in and around America's leading universities?

(2) Can these responses, or some modifications of them, be used to encourage excellence in research at other institutions that are striving for increased productivity and quality during hard times?

T. N. Clark noted that "various characteristics of universities and university systems influence their openness to innovation: funds, value climate, and competition" [14, p.16-8]. The higher the financial support, the greater the innovation; the more eminent the institution, the greater the innovation; the more competitive the system, the more innovative the institutions within it. Stanford and UC-Berkeley, located in the San Francisco area, meet Clark's criteria for high innovation; MIT and Harvard, located in the Boston area, do so as well. All four institutions are well-funded and prestigious, located in highly competitive research environments. Boston and San Francisco, areas in contention for supremacy of the nation's high technology industry, offer fertile seedbeds for the emergence of organizational forms that might be considered as models for improving information processing within the rest of American society.

The goal of this research study, which examines the research environments of four leading universities, is to develop hypotheses which might later lend themselves to testing. Increasingly, higher education researchers are employing the case study approach. The choice is sensible since case studies permit longitudinal analysis and consideration of cause-effect relationships. Empirical studies at the early developmental stage of higher education research need to concentrate more on generating hypotheses than on testing hypotheses.

University committee reports and institute publications were used to identify and evaluate organizational responses in use at these institutions. Interviews conducted during July/August 1983 at Stanford University and the University of California, Berkeley added perspective to the analysis. Telephone interviews with institutional leaders at Harvard University and the Massachusetts Institute of Technology offered additional insights.[2]

The problems associated with assessing cost/benefit ratios in the area of research productivity are complex and require a type of financial analysis that is not undertaken in this paper. Some of the issues that need to be considered in that analysis, however, are identified. Organizational forms that might be worthy of replication in other institutional settings are described.

Findings

The creative organizational responses of Berkeley, Harvard, MIT, and Stanford to their internal and external environments offer insights regarding effective and efficient forms of organized research units (ORU's). If the university were considered an organizational umbrella, then it might be thought to shelter a variety of departments or institutes that in themselves constitute more or less "independent small-scale organizations" [41, p.97]. The flexibility--diversity, ambiguity, and slack--found in the larger multiversity only adds to the potential for autonomy and freedom of action within the smaller academic units. ORU's may be classified by differences in research orientations (whether the unit stresses research leading toward publication, or applications, or patents, or the training of new researchers, or toward research with a social significance); differences in research output (articles and books, proposals, prototype devices and patents); and differences in research settings (contrasting patterns of influence that operate to determine research priorities and the organization of work in the laboratory) [15, p.370]. All types of ORU's were found operating within and around Berkeley, Harvard, MIT and Stanford.

Stanford and MIT: Assertive Responses to the Research Environment

From 14th (1925) to 2nd (1982), Stanford University steadily advanced in comparative rank among major American universities. On the Stanford campus, Frederick Terman's influence as provost was credited with strengthening research and graduate education. Terman foresaw that the federal government would provide a major source of funding for research and graduate education and encouraged Stanford scientists to respond and initiate contact; at the same time that federal research contracts and grants were flowing in, Terman encouraged Stanford scientists and engineers to cement their relationships with the high technology industry emerging in the San Francisco area [83, p.305-6]. Financially and administratively, Terman encouraged a spirit at Stanford that recognized and rewarded creativity and innovation, that promoted technological advancements and rewarded risk-taking.

The increase in perceived excellence at Stanford, based on the evaluation of academic departments, may be attributed--at least in part--to organizational responses on the part of that institution to its research environment. In the area of applied research, few organizational units have achieved the world-wide prominence of the Stanford Research Institute (now called SRI International); in the area of basic research, few organized research units had achieved the international acclaim of the

Center for Advanced Study in the Behavioral Sciences located on the Stanford campus. These two independent organized research units offer excellent demonstration of the advantages that external, loosely coupled research units can offer a university in the maximization of faculty productivity.

SRI International is a private and independent professional organization that was founded in 1946 under the auspices of Stanford University. The university provided the organization's initial leadership and financial resources. In 1970, SRI International became fully independent, with the transfer of control from Stanford University to SRI's own independent Board of Directors. In his 1951 doctoral dissertation, O'Bryne noted that "of the several institutes at Stanford, the Stanford Research Institute has by far the greatest autonomy: it alone has a separate Board of Directors" [59, p.62]. As emphasized by Orlans, "The divorce of 1970 gave de jure recognition to the de facto separation of many years standing" [61, p.35].

SRI from its beginning perceived itself as a problem-solving organization--usually on a national or international scale. With annual revenues from research and consultation presently exceeding $165,000,000, with a professional staff of over 2,000 persons representing more than 110 disciplines, SRI's potential to form matrix teams to address complex problems is evident. SRI maintains a continuous process of identifying both growing and diminishing fields of need and adjusting to ever changing market

circumstances. The organization's work remains diversified, thus allowing it to support and maintain a well-educated staff with diverse capabilities. Excellence in staff, facilities, and work environment remain SRI's hallmark. As a private and independent organization, SRI International offers many insights to American higher education regarding alternative ways of managing the research environment. Advantages which might accrue to universities that maintain association/affiliation with research organizations of its type are apparent--particularly with regard to the potential for collaborative activities on large research projects. The increased competitiveness of the environment may actually help to attract additional research support into the area.

In 1954, the Center for Advanced Study in the Behavioral Sciences, located on the Stanford campus, was established by the Ford Foundation as one element in a general plan to increase "knowledge of the principles which govern human behavior." As described in the Center's general information flyer, "the Center was to provide the mechanism by which distinguished and very promising scholars working in universities and related institutions could increase their competence, broaden their perspectives, and, in a specially designed setting, do the original work for which they were already prepared." Since 1954, the Center has awarded up to 50 residential postdoctoral fellowships each year to scientists and scholars from this country and abroad who showed great accomplishment and/or promise. Fellowship award required a period of residence in the vicinity of the Center.

The Center for Advanced Study in the Behavioral Sciences in Stanford, California serves as an international model for interdisciplinary research. For example, the National Institute for Advanced Study in the Humanities and Social Sciences in the Netherlands was created as a result of the influence of a Dutch linguist following his experience as a Center Fellow. The new National Humanities Center established at the Research Triangle in North Carolina was explicitly modeled after the Center, and most of the major figures involved in planning and promoting that Center were former Fellows.

The Center overlooks Stanford University from a secluded hilltop. It is chartered in the State of California as a nonprofit organization devoted to education and research. As such, it is as an example of an independent organizational response to interdisciplinary research. The very existence of the Center for Advanced Study in the Behavioral Sciences, so close to the University of California, Berkeley, and Stanford University, ranked first and second for academic excellence in the latest national surveys, calls attention to the great benefits accrued to institutions located in a world-class intellectual environment. The fact that Stanford University values its proximity to the Center for Advanced Study in the Behavioral Sciences is evidenced by its one dollar a year rental fee for use of the Center's ideal hilltop location [Interview, Gardner Lindzey, July 29, 1983]. Donald Kennedy, President of Stanford University and a former Fellow, understands the great

advantage of a close relationship with the Center for Advanced Study in the Behavioral Sciences--particularly for a university that is striving for academic excellence at the highest levels.

Was it possible that Stanford's special relationship with two world-class, independent research organizations could account for some of the special vitality displayed in its research effort? SRI International and the Center for Advanced Study in the Behavioral Sciences are examples of independent organized research units that hover around a major research university, making it possible for faculty to interact at close range with internationally renowned academics as well as with business/industrial/governmental representatives in the pursuit of research vitality.

In reviewing the unique characteristics of MIT's research effort, it is useful to consider the 1976 Report of the Committee on MIT Research Structure. "We believe it is essential to preserve the great strengths of MIT. The high value placed on innovation and its willingness to take risks in an uncertain environment have always been its hallmark. The comparatively minimal administrative and intellectual barriers between disciplines have made possible a degree of collaboration and cooperation often unknown at other institutions" [12, p.4-5]. MIT's emphasis on innovation and risk-taking in an uncertain environment and on high levels of communication between disciplines is used on campus to explain its rise in the latest

prestige ranking. This increase in perceived academic excellence, like that of Stanford University, may be attributed--at least in part--to organizational responses on the part of both institutions with regard to the research environment. MIT's organizational reform has been primarily internal; Stanford's external. MIT's response involves a new definition of ORU faculty. As noted by MIT's Committee on Research Structure, "by opting in a controlled way for a broader definition of faculty rather than accepting a static faculty bound by traditional rules of tenure, endowment, and faculty-student ratio, MIT will retain its responsiveness, breadth, and vitality which will enable it to contribute to the changing needs of the country" [12, p.119]. MIT's broader definition of faculty encourages individuals associated with organized research units to identify themselves more closely with the institution's regular faculty, thus increasing their participation and involvement in university-wide activities.

As noted in the 1976 Report of the Committee on MIT Research Structure, "In the next decade expansion of the center and laboratory research modes closely coupled to department and cross-departmental groups may be the principal mechanism by which MIT can enter new fields and bring new researchers into the community" [12, p.85]. Through an expanded use of institutionally affiliated centers and institutes, MIT has demonstrated an internal organizational response to the intellectual barriers between disciplines and has thus encouraged a degree of col-

laboration and cooperation unknown among American institutions of higher learning. As observed by Albert Teich, "So far, however, MIT seems to be alone in viewing its ORU's in this light. It does not appear that other research universities are following MIT's lead--at least as a matter of stated policy. On the other hand, the results of the National Research Council survey suggests that the nonfaculty research staffs of many universities are growing rapidly" [79, p.103].

MIT's Affiliates Program demonstrates another pioneering effort in organizational form on the part of one of the nation's most innovative research universities. In return for a membership fee, companies receive "a window into the university's research, through mutual visits, conferences, and publications" [60, p.72]. The effort earns MIT about six million dollars in membership fees from three hundred companies. The Affiliates Program permits "industrial scientists to tap into the university laboratories for new ideas or for help with specific problems that have risen within their own laboratories" [42, p.170]. The arrangement raises concerns of academic freedom and institutional autonomy that will be addressed later in the paper.

MIT's Development Foundation is another innovative organizational form that seeks "to actively help form new companies around technology that the faculty develop and even acts as a source of venture capital" [20, p.120]. MIT represents one of our nation's first concerted university efforts to respond organ-

izationally to the challenge of the information-processing society. That university's struggle to cope with the problems and issues that its choices have raised should be watched closely by the rest of American higher education.

Berkeley and Harvard: Defensive Responses to the Research Environment

Berkeley and Harvard have been America's preeminent research universities for the past several decades. Both great institutions have been experiencing relative difficulty. Berkeley's unreliable financial support, rigid committee governance system, and inability to respond effectively to the development of new academic fields [31, 54, 80], and Harvard's rigid faculty tradition and sudden extensive involvement with business and industry [11, 35] pose long-range problems for these two outstanding research universities. They, in turn, are responding--at least in part--with the development of new organizational forms.

The University of California at Berkeley has long been noted for excellence in research across a wide range of graduate programs. Lately, however, the foundations of its excellence have begun to deterioriate as a result of the financial drought affecting the nation [31, p.20]. In addition, Berkeley's "scientists with similar interests, scattered over many departments and research facilities, have had trouble finding each other" [80, p.45]. Berkeley's outstanding biological scientists,

housed in different departments, had not been able to work collaboratively within that institution, nor gain recognition for the emerging fields they represented outside of Berkeley.

In an effort to maintain national prominence in the biological sciences, the leadership of UC-Berkeley has developed a system for reorganizing departments within the area. As a result of the problem of failing to develop strong faculty groups in newer subject areas, Berkeley leadership created an Advisory Council on the Biological Sciences as the key instrument for rebuilding biology at Berkeley. The Council, consisting of nine distinguished biologists drawn from different sub-fields, exercised an authority which rested on the reputation of its members as well as on the power of the chancellor. The Council has been a mechanism for overriding departmental authority on crucial issues. "On the organizational side, the chancellor has put all the biology departments at Berkeley into a kind of receivership under the authority of the Advisory Council--a condition in which the departments no longer have the ordinary degree of control over their own recruitment of academic staff or graduate students, their course offerings, or their assignment of laboratory space and facilities to their own members" [80, p.48]. Thus the University of California at Berkeley has been experimenting with a governance process that can help to reorder the departmental boundaries in an academic area so that the reorganized units are less damaging to the development of new fields of study.

In the tradition of that institution's great presidents, Derek Bok has gambled boldly with the future of Harvard University; his gamble, however, is fraught with dangers for American higher education. "The ivory tower rapidly disappeared" [10, p.7], Bok observed; and he, as president of Harvard, is lowering the drawbridges that surround the university to American industry and business. Observing that "as the research university has grown in influence, a measure of scholarly independence has been lost" [10, p.26], Bok more recently signed a multibillion dollar contract with DuPont [75, p.494]. Funding advantages do not come without costs to the research process. The subjects that faculty members choose to investigate are at times influenced by the opportunities to obtain external support. Sometimes subtle dependencies are developed on patrons whose influence poses a threat to scholarship. "Universities are gradually losing control of activities carried on within their walls" [82, p.46]. Yet, little can be done to slow this movement across the drawbridges. The pattern is set, fraught with challenges to academic freedom, governance, and institutional autonomy. The question is asked by Bok, "Could universities enter the marketplace without subverting their commitment to learning and discovery" [11, p.24]? Whatever the answer to that question, Harvard's path is clear: "consulting arrangements, industry-associate programs, patent licensing, research agreements with individual firms or groups of companies--all these afford useful opportunities to stimulate technological innovation" [11, p.35]. The drawbridges were down, "social responsibility" [10]

was in, and Harvard was again redirecting the course of American higher education. As Bok warned, "the causes for concern flow from an uneasy sense that programs to exploit technological development are likely to confuse the university's central commitment to the pursuit of knowledge and learning" [11, p.26].

Conclusions and Concerns

In the years ahead, as the university becomes a major force in the information-processing society, its research function will steadily grow in importance. During the time of transition, however, the university will undergo an identity crisis of historical proportions--as far reaching as that experienced in early land grant university days. University administrators would do well to consider Derek Bok's advice regarding "the three basic standards for decision making in the new context: protection of academic freedom, preservation of institutional autonomy, and application of concepts of social responsibility" [37, p.582]. As the drawbridges are dropped around the university under the standard of "social responsibility" (the application of useful knowledge to the solution of social problems), "the essential tension between the competitive ethic of the free enterprise system, with its legitimate need for secretiveness, and the cooperative ethos of the academy as a community of independent scholars linked by mutual adherence to standards for testing the truth and for freely communicating the results" [30, p.xiii] will be tried and tested. Principal

concerns will include "the potential erosion of academic values, the conflicts of interests of individuals, and the possible leakage of proprietary information" [44, p.74]. Additional concerns will include the question of exclusivity of patents and the use of university facilities for commercial gain. During the times of transition increased income and additional student opportunities will emerge. Public confidence, however, may be challenged by conflict of interest charges and a university atmosphere inhibiting free and open communication.

Adaptations to the information-processing society will involve the development of new organizational forms that encourage collaboration in research while not resolving the existing tension between an emphasis on individual performance and restraints on individual performance. As Sir Edward Bullard noted, "Perhaps the key to the successful organization of a research establishment is to run it so that the staff know that they can easily leave for a better job, but find it so rewarding a place to work in that most of them stay" [13, p.272].

The collaborative work structures that exist in and around America's leading research universities should be monitored for effectiveness and efficiency, and the more cost/effective models should be considered by other research institutions in our society. The task will not be easy as the manipulation of cost data to provide information for use in decision-making within the research area is especially complex. Cost per student credit

hour does not recognize the greater faculty time associated with research at advanced levels [84, p.17]; price schedules do not reflect "a financial rate of return on faculty effort inversely proportional to the prestige of the activity" [32, p. 25]. Productive, cost/ effective models should be identified and recommended for replication at other research institutions. The search should continue for "a system or framework within which continuous innovation, renewal and rebirth can occur" [27, p.5].

The search for creative organizational responses should be extended well beyond the four research universities considered in this paper, and these four institutions, as well as their environments, need to be analyzed more comprehensively. As Ralph Tyler noted in his letter of March 14, 1985, "One solution that was not found in the four universities you studied was the one developed at the University of Chicago under the leadership of Robert Hutchins when I was dean of the Division of Social Sciences. We viewed departments as certifying the legitimacy and competency of persons who exercised its discipline. Metaphorically, the department was the home while the committee was the workplace... Funds were budgeted by tasks not departments." Hutchins' model of a university environment arranged to force, in a polite way, the association of scholars across disciplinary lines was thus realized via a structured committee system. The remnants of Hutchins' interdisciplinary organizational experiments at the University of Chicago should be

of interest to a society in search of approaches for improving information processing.

The organizational responses of Berkeley, Harvard, MIT, and Stanford to their changing environments offer insights about emerging forms of ORU's. Each of these organizational models for revising the research environment should be considered by other universities hoping to achieve excellence in research. Foremost is a need for increased collaboration. Considering Berkeley and Stanford, Clark Kerr noted, "They both needed each other: They each helped create an intellectual community for the other...Neither one could have done as well historically by itself" [4, p.34-5]. Competitive environments increase the vitality of systems contained within them by symbiosis, Collaboration in highly competitive environments is clearly associated with greater productivity in research at all system levels. At a time when the university is being encroached upon on all fronts, more havens such as like those afforded to scholars by the Center for Advanced Study in the Behavioral Sciences are needed to preserve the university's ancient virtues. At a time when, in many cases, successful research requires the pooling of resources and understandings, the experiences of MIT with organized research units become worthy of attention and consideration. Possibly it is time to consider David Riesman's call for "the recruitment of faculty . . . as members of collaborative teams," as well as the overhaul of our systems of selection, evaluation, and promotion of faculty to

reflect these new realities [68, p.234]. The collaborative work structures located in and around our nation's leading research universities offer insights for improving information processing within the rest of American society.

Footnotes

[1]Rating the quality of a scholar's (department's) research as a measure of productivity while intuitively sound was operationally difficult to implement.

[2]Additional information about the research environments within and around Harvard and MIT will be gathered during summer 1985. The author has been appointed Associate in Education-Administration, Planning and Social Policy Area, Graduate School of Education, Harvard University, June 15 - September 15, 1985. He plans to conduct in-depth interviews with institutional leaders and review archival data including histories, university committee reports, financial documents, and institute publications. Both the Stanford/Berkeley and the Harvard/MIT trips were/are being sponsored by Oklahoma State University's Office of Academic Affairs. From 1983-84, the author served as founding chair of Oklahoma State University's Research Group for the Behavioral Sciences - a sixteen member interdisciplinary research team whose activities have been supported by OSU's Office of Academic Affairs [26].

References

1. Astin, H. S. "Academic Scholarship and its Rewards." In Advances in Motivation and Achievement, edited by M. Maeher. Greenwich, Connecticut: JAI Press, 1984.

2. Bach, M. L., and R. Thornton. "Academic-Industrial Partnerships in Biomedical Research: Inevitability and Desirability." Educational Record, 64 (Spring 1983), 26-32.

3. Baer, W. S. "The Changing Relationships: Universities and Other R & D Performers." In The State of Academic Science: Background Papers, edited by B. L. R. Smith and J. J. Karlesky. New York: Change Magazine Press, 1978.

4. Basu, J. E. "The Etiquette of Gentlemanly Competition." Change, 16 (March 1984), 30-37, 43-44.

5. Bayer, A. E., and Astin, H. S. "Sex Differentials in the Academic Reward System." Science, 188 (1975), 796-802.

6. Ben-David, J. Fundamental Research and the Universities. Paris: Organization for Economic Cooperation and Development, 1961.

7. Berelson, B. Graduate Education in the United States. New York: McGraw-Hill, 1960.

8. Bess, J. L. "Maps and Gaps in the Study of College and University Organization." Review of Higher Education, 6 (Summer 1983), 239-252.

9. Bloland, H. G. "Interpretive Sociologies and the Study of Higher Education Organizations." Review of Higher Education, 3 (Fall 1979), 1-14.

10. Bok, D. C. Beyond the Ivory Tower: Social Responsibilities of the Modern University. Cambridge: Harvard University Press, 1982.

11. Bok, D. C. "Business and the Academy: President's Report." Harvard Magazine, 83 (May/June 1981), 23-35.

12. Brown, G. M. et al. Report of the Committee on MIT Research Structure. Cambridge: Massachusetts Institute of Technology, 1976.

13. Bullard, E. "What Makes a Good Research Establishment?" In The Organization of Research Establishments, edited by J. Cockcroft. Cambridge: University Press, 1965.

14. Clark, T. N. "Institutionalization of Innovations in Higher Education: Four Models." Administrative Science Quarterly, 13 (June 1968), 1-25.

15. Cole, G. A. "Classifying Research Units: A Typology." In Scientific Productivity: The Effectiveness of Research Groups in Six Countries, edited by F. M. Andrews. London: Cambridge University Press, 1979.

16. Cole, J. R., and S. Cole. Social Stratification in Science. Chicago: University of Chicago Press, 1973.

17. Committee on Continuity in Academic Research Performance of the National Academy of Sciences. Research Excellence through the Year 2000: The Importance of Maintaining a Flow of New Faculty into Academic Research. Washington, D.C.: National Academic of Sciences, 1979.

18. Crane, D. Invisible Colleges: Diffusion of Knowledge in Scientific Communities. Chicago: University of Chicago Press, 1972.

19. Crane, H. D. The New Social Marketplace: Notes on Effecting Social Change in America's Third Century. Norwood, NJ: Ablex Publishing, 1980.

20. Declercq, G. V. "A New Look at the Two Cultures: The New Economic Responsibility of the University." International Journal of Institutional Management in Higher Education, 5 (July 1981), 117-122.

21. Dressel, P. L., F. C. Johnson, and P. M. Marcus. "The Proliferating Institutes." Change, 1 (July/August 1969), 21-24.

22. Fox, M. F., and C. A. Faver. "Independence and Cooperation in Research: The Motivations and Costs of Collaboration." Journal of Higher Education, 55 (May/June 1984), 347-359.

23. Friedman, R. S., and R. C. Friedman. The Role of University Organized Research Units in Academic Science. University Park: Pennsylvania State University, Center for the Study of Higher Education, 1982.

24. Fulton, O., and M. Trow. "Research Activity in American Higher Education." Sociology of Education, 47 (Winter 1974), 29-73.

25. Gamson, Z. F. et al. Liberating Education. San Francisco: Jossey-Bass, 1984.

26. Gardiner, J. J. "Excellence in Research: A Model for the Behavioral Sciences." Paper presented at conference co-sponsored by the American Educational Research Association and the Association for the Study of Higher Education, San Francisco, October 1983.

27. Gardner, J. W. Self-Renewal: The Individual and the Innovative Society. New York: Harper and Row, 1964.

28. Garvin, D. A. The Economics of University Behavior. New York: Academic Press, 1980.

29. Gross, N. "Organizational Lag in American Universities." Harvard Educational Review, 33 (Winter 1963), 58-73.

30. Hackney, S. "Prologue." In Partners in the Research Enterprise, edited by T. W. Langfitt. Philadelphia: University of Pennsylvania Press, 1983.

31. Heyman, I. M. "The Perspective from Berkeley: Preserving a Reputation for Excellence." Change, 16 (March 1984), 20-22.

32. Hoenack, S. A., and A. L. Norman. "Incentives and Resource Allocation in Universities." Journal of Higher Education, 45 (January 1974), 21-37.

33. Ikenberry, S. O., and R. C. Friedman. Beyond Academic Departments: The Story of Institutes and Centers. San Francisco: Jossey-Bass, 1972.

34. Institute for Advanced Study. Annual Report for the Fiscal Year July 1, 1982 - June 30, 1983. Princeton: Princeton University Press, 1983.

35. James, W. Memories and Studies. New York: Longman, Green, and Company, 1911.

36. Jencks, C., and D. Riesman. The Academic Revolution. Garden City, NY: Doubleday, 1968.

37. Kerr, C. Review of Beyond The Ivory Tower: Social Responsibilities of the Modern University, by Derek Bok. Journal of Higher Education, 54 (September/October 1983), 582-583.

38. Kerr, C. The Uses of the University: With a "Postscript--1972." Cambridge: Harvard University Press, 1972.

39. Klapp, O. E. "Meaning Lag in the Information Society." Journal of Communication, 32 (Spring 1982), 56-66.

40. Klitgaard, R. E. "The Decline of the Best? An Analysis of the Relationships Between Declining Enrollments, Ph.D. Production, and Research." Discussion Paper 65 D. Cambridge: Harvard University, Kennedy School of Government, May 1979.

41. Knorr, K. D., R. Mittermeir, G. Aichholzer, and G. Waller. "Leadership and Group Performance." In Scientific Productivity: The Effectiveness of Research Groups in Six Countries, edited by F. M. An[illegible]. London: Cambridge University Press, 1979.

42. Langfitt, T. W. "Epilogue." In Partners in the Research Enterprise, edited by T. W. Langfitt. Philadelphia: University of Pennsylvania Press, 1983.

43. Long, J. S., and R. McGinnis. "Organizational Context and Scientific Productivity." American Sociological Review, 46 (August 1981), 422-442.

44. Low, G. M. "The Organization of Industrial Relationships in Universities." In Partners in the Research Enterprise, edited by T. W. Langfitt. Philadelphia: University of Pennsylvania Press, 1983.

45. March, J. G. "Footnotes to Organizational Change." Project Report No. 80-A6. Palo Alto: Stanford University, Institute for Research on Educational Finance and Governance, April 1980.

46. March, J. G. "The Technology of Foolishness." In Ambiguity and Choice in Organizations, edited by J. G. March and J. P. Olsen. Bergen: Universitetsforlaget, 1976.

47. March, J. G., and H. A. Simon. Organizations. New York: John Wiley, 1958.

48. McHenry, D. E. (ed.). Academic Departments: Problems, Variations, and Alternatives. San Francisco: Jossey-Bass, 1977.

49. McPherson, M. S. "Value Conflicts in American Higher Education." Journal of Higher Education, 54 (May/June 1983), 243-278.

50. Merton, R. K., and H. Zuckerman. "Institutionalized Patterns of Evaluation in Science." In The Sociology of Science, edited by R. K. Merton. Chicago: University of Chicago Press, 1973.

51. Miles, R. H. "Findings and Implications of Organizational Life Cycle Research: A Commencement." In The Organizational Life Cycle, edited by J. R. Kimberly and R. H. Miles. San Francisco: Jossey-Bass, 1980.

52. Miles, R. H., and W. D. Perreault, Jr. "Organizational Role Conflict: HS Antecedents and Consequences." In The Study of Organizations, edited by D. Katz, R. L. Kahn, and J. S. Adams. San Francisco: Jossey-Bass, 1980.

53. Miller, A. C., and S. L. Serzan. "Criteria for Identifying a Refereed Journal." Journal of Higher Education, 55 (November/December 1984), 673-699.

54. Mortimer, K. P. Academic Government at Berkeley: The Academic Senate. Berkeley: University of California, Center for Research and Development in Higher Education, 1970.

55. Mortimer, K. P. "The Dilemmas in New Campus Governance Structures." Journal of Higher Education, 42 (June 1971), 467-482.

56. Murray, R. K. "On Departmental Development: A Theory." Journal of General Education, 16 (October 1964), 227-236.

57. National Academy of Sciences. Science and Technology: A Five-Year Outlook. San Francisco: W. H. Freeman, 1979.

58. National Humanities Center. The National Humanities Center. Research Triangle Park, North Carolina: National Humanities Center, 1984.

59. O'Bryne, E. "The Research Institutes of Stanford University." Ph.D. dissertation, Stanford University, 1951.

60. Omenn, G. S. "University-Corporate Relations in Science and Technology: An Analysis of Specific Models." In Partners in the Research Effort, edited by T. W. Langfitt. Philadelphia: University of Pennsylvania Press, 1983.

61. Orlans, H. The Nonprofit Research Institute. New York: McGraw-Hill, 1972.

62. Pelz, D. C., and F. M. Andrews. Scientists in Organizations: Productive Climates for Research and Development. New York: John Wiley, 1966.

63. Peterson, M. W. "Decline, New Demands, and Quality: The Context for Renewal." Review of Higher Education, 7 (Spring 1984), 187-203.

64. Peterson, M. W. "Preface." Review of Higher Education, 6 (Fall 1982), v-vi.

65. Phillips, D. I. "Introduction: The Future of Academic Research." In Research in the Age of the Steady-State University, edited by D. I. Phillips and B. S. P. Shen. Boulder, Colorado: Westview Press, 1982.

66. Pondy, L. R., and D. M. Boje. "Bringing Mind Back In: Paradigm Development as a Frontier Problem in Organization Theory." Discussion Paper. Urbana: University of Illinois, Department of Business Administration, Organization Behavior Group, 1976.

67. Reskin, B. F. "Scientific Productivity and the Reward Structure of Science." American Sociological Review, 42 (June 1977), 491-504.

68. Riesman, D. "Afterword." In Liberating Education, edited by Z. F. Gamson. San Francisco: Jossey-Bass, 1984.

69. Robinson, D. Z. "Will the University Decline as the Center for Scientific Research?" Daedalus, 102 (January 1973), 101-110.

70. Silverman, R. J. "Diffusion of Educational Knowledge through Journals: Gatekeepers' Selection Criteria." Viewpoints in Teaching and Learning, 54 (April 1978), 1-22.

71. Simon, H. A. "Applying Information Technology to Organization Design." Public Administration Review, 33 (May/June 1973), 268-278.

72. Simon, H. A. "Information-Processing Models of Cognition." Journal of the American Society for Information Science, (September 1981), 364-377.

73. Simon, H. A. "On the Concept of Organizational Goal." Administrative Science Quarterly, 9 (June 1964), 1-22.

74. Simon, H. A. "What Computers Mean for Man and Society." Science, 195 (March 1977), 1186-1191.

75. Slaughter, S., and E. T. Silva. "Service and the Dynamics of Developing Fields: The Social Sciences and Higher Education Studies." Journal of Higher Education, 54 (September/October 1983), 481-499.

76. Smith, B. L. R. The Rand Corporation. Cambridge: Harvard University Press, 1966.

77. Smith, R., and F. E. Fiedler. "The Measurement of Scholarly Work: A Critical Review of the Literature." Educational Record, 52 (Summer 1971), 225-232.

78. Stockton, R. "University Based Research Units: A Perspective." Journal of Research and Development in Education, 5 (Summer 1972), 3-11.

79. Teich, A. H. "Research Centers and Nonfaculty Researchers." In Research in the Age of the Steady-State University, edited by D. I. Phillips and B. S. P. Shen. Boulder, Colorado: Westview Press, 1982.

80. Trow, M. A. "Reorganizing the Biological Sciences at Berkeley." Change, 15 (November/December 1983), 28-29, 44-52.

81. Van de Graaf, J. H. "Can Department Structure Replace a Chair System? Comparative Perspectives." Yale Higher Education Research Group Working Paper 46. New Haven: Yale University, Institution for Social and Policy Studies, June 1980.

82. Wallis, W. A. "Centripetal and Centrifugal Forces in University Organization." In The Contemporary University: U.S.A., edited by R. S. Morison. Boston: Houghton Mifflin Company, 1966.

83. Walsh, J. "Stanford's Search for Solutions." In Academic Transformation: Seventeen Institutions Under Pressure, edited by D. Riesman and V. A. Stadtman. New York: McGraw-Hill, 1973.

84. Walters, D. L. Financial Analysis for Academic Units. AAHE/ERIC - Higher Education Research Reports, No. 7. Washington, DC: American Association for Higher Education, 1981.

85. Wanner, R. A., L. S. Lewis, and D. I. Gregorio. "Research Productivity in Academia: A Comparative Study of the Sciences, Social Sciences, and Humanities." Sociology of Education, 54 (October 1981), 238-253.

86. Washburn, B. H. "Standards of Departmental Excellence: An Investigation of the Criteria Used for Judging Excellence by Selected Departmental Faculties of a Research University." Ph.D. dissertation, Stanford University, 1980.

87. Webster, D. S. "America's Highest Ranked Graduate Programs, 1925-1982." Change, 15 (May/June 1983), 14-24.

88. Weick, K. E. "Educational Organizations as Loosely Coupled Systems." Administrative Science Quarterly, 21 (March 1976), 1-19.

89. Woodrow, R. J. Management for Research in U.S. Universities. Washington, DC: National Association of College and University Business Officers, 1978.

90. Ziman, J. M. "Information, Communication, Knowledge." Nature, 224 (October 1969), 318-324.

91. Zuckerman, H. "Nobel Laureates in Science: Patterns of Productivity, Collaboration, and Authorship." American Sociological Review, 32 (1967), 391-403.

92. Zuckerman, H. Scientific Elite: Nobel Laureates in the United States. New York: The Free Press, 1977.

NOTE: Numerous annual reports, institute publications, and university committee reports not found among the references were reviewed as part of this research effort. Information contained in these secondary sources was used in presenting center and/or institute profiles.